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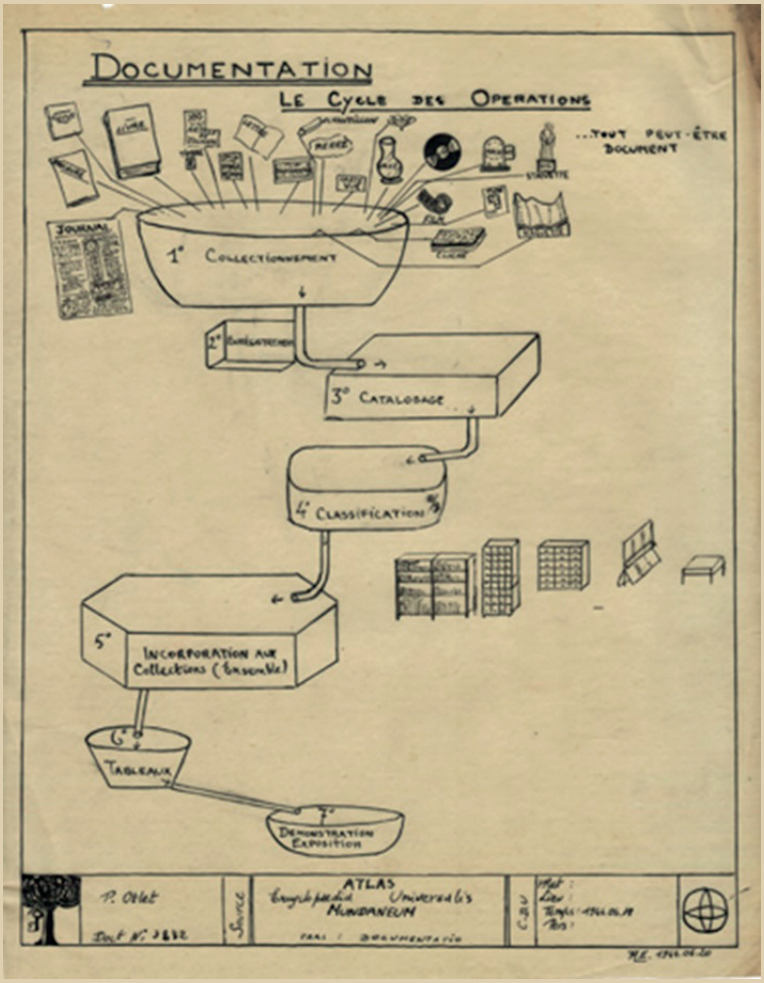

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Risk Communication and Misunderstandings

The Healthcare Dominion Case

Monica Consolandi, Simone Magnolini, Mauro Dragoni*

Abstract: Risk communication constitutes a complex area of discourse within the healthcare sector, defined by the inherent risk of misunderstandings between healthcare providers and patients and the challenges associated with effectively conveying information about risks. A significant barrier to improving this communication lies in enhancing healthcare providers' awareness of the implicit nuances embedded in pre-operative risk discussions. This study seeks to address this gap in the existing literature by exploring the issue through the framework of the philosophy of language, with a particular focus on pragmatic analysis as a tool to uncover implicit meanings in doctor-patient interactions. By applying this approach to examine instances of risk evaluation of cardiac surgery, the study provides an empirical analysis of collected data, highlighting the limitations of contemporary models in detecting misunderstandings. Finally, the study outlines potential directions for future research, emphasizing the critical need to advance strategies for improving risk communication in medical contexts.

Keywords: Risk communication, Doctor-Patient Interaction, Misunderstandings, LLMs, Artificial Intelligence.

1. Introduction

Risk communication is a complex and heavily debated topic within the context of doctor-patient interactions (Consolandi 2023). Although medicine adheres to evidence-based principles (Timmermans and Angeli 2001; Tanenbaum 1999), it remains inherently imprecise, characterized by uncertainty and probabilistic reasoning (Curi 2017; Diamond-Brown 2016; Sadegh 2012; Whitby 1951). In formal interactions, physicians are tasked with conveying information regarding treatment success rates, potential complications, and side effects. This process inherently involves uncertainty, as medical knowled-

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ge is predominantly probabilistic rather than deterministic. Risks in medicine - such as treatment failure, surgical complications, or post-operative recovery challenges - are unavoidable and necessitate careful communication (Zipkin et al. 2014; Visschers et al. 2009).

The assessment of risks must balance the patient's best interests, prioritizing the communication of high-stakes risks. For example, while comparing treatment options for minor conditions versus surgical procedures, the risk-benefit ratio becomes more critical in the latter. Several efforts have sought to categorize uncertainty in relation to medical risks. Uncertainty may stem from its source, such as incomplete information, inadequate understanding, or equally viable alternatives, or from its issue, namely the specific outcomes, situations, or alternatives to which the uncertainty applies (Lipshitz and Strauss 1997; Han et al. 2011).

Weinfurt (2008) expands on Miller and Joffe's typology of uncertainty by identifying additional sources, including uncertainty about causal agents, the validity of surrogate endpoints, the generalizability of findings (e.g., using past data to predict outcomes in new cases), estimation errors, and the population-level nature of statistical estimates, which may not directly apply to individual patients. In phase 1 oncology trials, Miller and Joffe (2008) emphasize that effective informed consent requires clinicians to clearly communicate the probability, magnitude, and duration of potential benefits and risks, along with the associated uncertainties. As Weinfurt highlights, these tasks are not straightforward. Physicians must possess a robust understanding of both the benefits and risks of medical interventions, which is complicated by the inherent uncertainties. Simultaneously, patients must comprehend the information provided by their physicians, a process that Gigerenzer and Edwards (2003) identifies as critical. This dual requirement underscores the importance of both the content and the manner in which information is conveyed. Effective risk communication necessitates specific skills, as patients are often confronted with sensitive topics, including risks of mortality. This dimension has garnered significant interest among psychologists, as poor communication can exacerbate emotional distress (Wells and Kaptchuk 2012). Conversely, clear and empathetic communication fosters trust between doctors, patients, and their families (Wei et al. 2020; Riva et al. 2012; Heyland et al. 2002). Studies have shown that effective risk communication directly correlates with higher levels of trust in the doctor-patient relationship (Engdahl and Lidskog 2014; Duffy et al. 2004).

Risk communication is also explored in broader discussions, including its role in informed consent (General Medical Council 1998), patient rights (Ibrahim et al. 2018), and the physician's ethical obligation to disclose the truth (Jackson 1991). These issues have been examined extensively in clinical ethics and bioethics (Chakrabarty et al. 2012; Gillett 2006), as well as through

the lens of the philosophy of language (Weinfurt et al. 2003; Weinfurt 2018). Philosophical analyses of language explore the implications of verbal expressions, particularly their ability to clarify or obscure meaning (Sbisà 2007). When applied to doctor-patient interactions, such analyses have the potential to enhance speakers' awareness, improving overall communication during discussions of risk.

This paper seeks to address the challenge of detecting misunderstandings in risk communication dialogues within healthcare. Despite its importance, this research topic has received limited attention in the literature due to the scarcity of resources and the complexity of the task (Ardissono et al. 1997). We begin by examining this issue from a philosophical perspective, focusing on the implicit dimensions of dialogue and the role of trust. We then present use cases drawn from a dataset, detailing a preliminary classification of misunderstandings observed in analyzed dialogues. The classification framework used for annotating misunderstandings follows the codebook developed by Rossi and Macagno (2020), which specifically addresses risk communication in healthcare. Finally, we assess the capabilities of state-of-the-art large language models (LLMs), such as OpenAI's GPT-4, in recognizing and analyzing misunderstandings. This assessment is conducted through a qualitative analysis of a single dialogue, shedding light on the limitations and opportunities for improving automated approaches to this task.

2. Language and its dimensions

The implicit dimension of discourse carries profound meaning, and philosophers of language have long sought to uncover its nuances. Grice (1975) was the first to introduce the concept of implicatures to describe these implicit aspects of communication. According to the *Stanford Encyclopedia of Philosophy*, implicature refers to either «(i) the act of meaning or implying one thing by saying something else, or (ii) the object of that act». For example, when one asks, "Do you know what time it is?" the expected response is not a mere "Yes", but an indication of the actual time, such as "Noon" or "It's late". Implicitly, the question communicates more than its literal meaning: it may express a lack of knowledge about the time or, alternatively, inquire whether someone is punctual. The same wording thus conveys varied implications depending on the context and intent.

Gricean implicatures reveal that communication relies not only on explicit content but also on the unspoken meanings that arise through what remains unsaid. Implicatures can be categorized into two types: (i) those that are conventional and inevitable, and (ii) those resulting from deliberate choices by the speaker. Both types are context-dependent and essential for effective communication. The first category – conventional implicatures – comprises those

that are essential for facilitating communication. For instance, when a doctor offers a patient "some water", it is implicitly understood that the water will be provided in a drinkable form and served in a suitable container. Such conventions enable smooth interactions by omitting unnecessary details. However, these conventions are culturally contingent and may vary significantly across societies (Austin 1962). Misunderstandings can arise in cross-cultural contexts, as exemplified by the differing meanings of a nod in Greece versus other cultures. These variations highlight the concept of "felicity" (Austin 1962), which governs whether a conversational convention is successfully applied in a given context. The second category – conversational implicatures – is more intricate, as it arises from intentional choices by the speaker. These implicatures depend on factors such as clarity, complexity, and context. For example, when a dermatologist says "Bring me your exams tomorrow", the speaker does not explicitly state the time, location, or type of exams. The implicature assumes that the exams should pertain to skin pathology, be delivered the next day, and be brought to the doctor's office. Unlike conventional implicatures, conversational implicatures are context-specific and rely on the interlocutors' shared understanding.

While Blečić (2017) suggests that both doctors and patients should avoid conversational implicatures, we contend that implicatures are an unavoidable component of communication. However, we agree with Blečić that both parties could benefit from enhanced skills in recognizing and interpreting implicatures. The philosophy of language seeks to systematize such interactions by illuminating implicit meanings, identifying gaps, and correcting misunderstandings. By analyzing implicatures in doctor-patient communication, we can map the interaction more comprehensively and address specific challenges arising from misinterpreted or missed meanings.

Grice's cooperative principle underpins effective communication, emphasizing that understanding in dialogue depends on the mutual recognition of a shared goal. This principle aligns with Wittgenstein's (1953) theory of language games, which posits that each speaker brings their own implicit "rules" to an interaction. These unspoken rules shape communication and can generate unease when participants' language games differ. Wittgenstein suggests that a shared "third language game" must emerge, comprising a compromise between interlocutors' distinct rules (Malherbe 2014). In the context of doctor-patient communication, this convergence requires openness from both parties to adopt shared rules within the interaction.

Combining Grice's cooperative principle with Wittgenstein's insights underscores that effective communication relies on mutual trust. Trust facilitates the creation of a shared linguistic framework and fosters a therapeutic alliance. To achieve this, speakers should adhere to Grice's four maxims: (i) the maxim of quality - be truthful; (ii) the maxim of quantity - provide the appropriate

amount of information; (iii) the maxim of relation - remain relevant; and (iv) the maxim of manner - be clear and orderly while avoiding ambiguity and obscurity. While violations of these maxims (e.g., through metaphors, irony, or hyperbole) may occur without breaching the cooperative principle, maintaining awareness of these guidelines ensures effective communication and helps interlocutors stay aligned. In this linguistic framework, both explicit content and implicatures contribute meaningfully to communication. Trust, as the foundation of this interaction, is essential for interpreting both the speakers' active contributions (maxims) and their passive contributions (implicatures). The implicit dimension of communication, though unspoken, plays a critical role in shaping discourse. However, when this dimension is marked by mistrust rather than trust, communication becomes significantly impaired. For instance, consider a scenario where you ask a housemate whether they have locked the apartment door. If you trust their response, a simple "Yes" suffices to conclude the conversation. However, if mistrust exists, you may ask additional clarifying questions, such as "Did you double-lock it? Did you use the latch? Is the alarm activated?". A similar dynamic applies in doctor-patient interactions. If a physician mistrusts a patient's adherence to prescribed medication, they may interrogate the patient with questions such as "Have you taken your pills? All of them? Every day? After meals, as instructed?". This lack of trust transforms the interaction into an interrogation, disrupting the clinical relationship.

These challenges become particularly pronounced during moments of risk communication. Trust, mutual understanding, and the ability to navigate implicatures are crucial for effective discussions of risks, where the stakes are inherently high (Chalmers 2002). Mismanagement of these implicit dimensions can lead to significant misunderstandings, undermining the therapeutic alliance and the quality of care (Consolandi et al. 2024).

3. Communicating risks

Effective communication is anchored in reciprocal trust, a principle critical not only for successful doctor-patient interactions but also for the broader doctor-patient relationship (Dugdale 2019; Jackson 2002). Trust, as previously emphasized, is foundational to building a robust therapeutic alliance. By applying the Gricean maxims, this alliance can be envisioned as a virtuous circle where trust and truth mutually reinforce one another. The concept of trust becomes clearer when dissecting its definitions. According to the Cambridge Dictionary, the noun "trust" is defined as «the belief that you can trust someone or something». Its verb form, "to trust," means «to believe that someone is good and honest and will not harm you, or that something is safe and reliable; to hope and expect that something is true». Trust, therefore, is inherently a

triadic relationship: "X trusts Y to do Z". In clinical settings, this is translated to "P (the patient) trusts D (the doctor) to do X (a specific action)", and conversely, "D trusts P in doing X".

Similarly, the concept of truth, defined as "the quality of being true", gains depth when considered alongside its adjective form, "true", which implies being «sincere or loyal, and likely to continue to be so in difficult situations» and «having all the characteristics necessary to be accurately described as something». Two recurring themes emerge from these definitions: (i) sincerity, loyalty, and reliability, which relate to the trustworthiness of the relationship, and (ii) accuracy, emphasizing the necessity of precise descriptions or evidence supporting the interaction (e.g., a specific treatment in the clinical context).

This dual aspect of trust and truth highlights a central challenge in risk communication: providing precise descriptions is often impractical or unhelpful when addressing open-ended subjects like risk. At the same time, withholding certain information can undermine trust, even though, as Klitzman (2007, 514) notes «the desire to establish trust can conflict with the imperative to disclose the whole truth». This tension complicates the virtuous circle of trust and truth, especially when truth must navigate patient expectations ("...will not harm you...") and the inherent uncertainties of communication. As Wittgenstein observed, every individual enters communication with their own language game, a unique system of rules shaped by personal experiences and roles. In doctor-patient interactions, these language games are distinct: the doctor, clad in professional attire and documenting the interaction in a medical record, represents the medical profession. The patient, by contrast, typically appears unwell and lacks visible markers of their symptoms. This juxtaposition underscores two primary systems of rules: those of the professional healthcare provider and those of the unwell individual. These roles carry profound implications. The doctor, bound by legal and ethical standards, assumes professional responsibility for the patient's life, while the patient, relying on the doctor's expertise, retains personal responsibility for their own well-being.

Within this framework, two levels of communication coexist: (i) the professional level and (ii) the personal level. The professional level pertains to the doctor's role as a representative of their medical profession. In this capacity, the doctor bears the responsibility to convey information about the patient's condition, treatment options, potential outcomes, and associated risks. Here, the patient plays a more passive role, primarily as a recipient of information. The personal level encompasses the emotional dimensions and personal histories of both parties. This level is where vulnerability, fear, and doubt come to the forefront. Unlike the professional level, both the doctor and the patient are active participants, bringing their personal narratives and emotional experiences into the interaction.

These two levels are intertwined, yet they reveal a double asymmetry in the doctor-patient relationship: i) the first asymmetry arises from the knowledge gap: the doctor, as the medical expert, possesses a depth of understanding about the patient's condition and body that far exceeds the patient's own knowledge. This expertise places the patient in a passive role on the professional level, where they depend on the doctor's guidance; ii) the second asymmetry highlights the dual role of the doctor. On one hand, they must maintain their professional identity and adhere to the boundaries of their role, ensuring clear and accurate communication within the context of medical care. On the other hand, the doctor is a human being with personal emotions and vulnerabilities, which can surface during interactions. Balancing these professional and personal dimensions is a challenge unique to the medical field. This dynamic is reflected in legal frameworks, such as Italy's Gelli-Bianco Law (n. 24/2017), which addresses criminal liability arising from medical errors, underscoring the gravity of professional responsibilities. These asymmetries reveal the complexity of doctor-patient communication, particularly in the realm of risk communication. Risk communication is not conducted in a neutral environment; it is shaped by the interplay of professional expertise, personal emotions, and the delicate balance of trust and truth. Successfully navigating this intricate dynamic requires sensitivity to the implicit dimensions of communication and a commitment to fostering mutual trust within the therapeutic alliance.

4. From theory to practice

This study approached the challenge of misunderstanding classification as a text classification task, which involves assigning a specific label or class to a given segment of text. As there are no directly comparable classification tasks currently available, we began developing the system from scratch. To address the task effectively, we selected *XLM-RoBERTa* (Conneau et al. 2020), a robust general-purpose language model, as the foundation for our system. *XLM-ROBERTA* is renowned for delivering state-of-the-art performance across multiple languages and a variety of tasks (Wang and Banko 2021). The pre-trained *xlm-roberta-base* model, freely available on the Hugging Face Model Hub (Wolf et al. 2020), provided an excellent starting point for adaptation to our specific task requirements.

Our dataset[1] consists of 32 doctor-patient interviews. In total, these interviews include 7,172 conversational turns, with an average of 230 turns per interview. These interactions were meticulously analyzed, and misunderstan-

[1] Dataset available at (Zenodo 2024). See Consolandi et al. 2020 and Consolandi 2024 for an exhaustive overview of the data collection and the methodology.

dings were manually annotated, yielding 320 instances of misunderstandings, representing 4.4% of the total conversational turns. We carried out an in-depth analysis of the misunderstandings and problematic understandings that surfaced during the doctor-patient interviews, and distinct patterns emerged based on the participants' roles. For doctors, the majority of these instances appeared during the anamnesis phase, where gathering a patient's medical history often introduced ambiguities or misinterpretations[2]. On the other hand, for patients and caregivers, misunderstandings were most prominent in discussions about future treatment plans, with a smaller but notable number occurring during the diagnosis phase. These findings underline how different phases of communication carry unique challenges depending on the role and perspective of each participant.

To fine-tune the model and assess its performance, we split the dataset into three parts following a typical 80/10/10 proportion. This resulted in a training set of 254 instances, while both the development set and test set contained 32 instances each. Importantly, for consistency and practicality during training, conversational turns containing more than 50 interactions were truncated at this limit. This step helped streamline the data without losing its core interpretability. However, as often happens with real-world datasets, we encountered a significant class imbalance, particularly in the training data, which raised concerns about the model's ability to generalize effectively across all types of misunderstandings. However, the test set was more balanced, better representing how misunderstandings naturally occur, which gave us confidence that the evaluation results would closely reflect real-world situations. That said, one limitation that surfaced during evaluation was the absence of certain classes in the test set, which could hinder the model's ability to fully adapt to all misunderstanding types.

To mitigate the imbalance issue in the training set, we opted for a simple yet effective strategy: random oversampling of the underrepresented classes. By increasing the representation of minority classes, this method ensures that the model has a fair opportunity to learn from all misunderstanding types, rather than being disproportionately biased toward the majority classes. This balanced approach of working with real-world distributions while addressing data limitations through targeted techniques strengthens the foundation of our classification system. By refining the training process and accounting for the inherent complexities in the data, we aim to improve the model's ability to identify and classify misunderstandings with greater nuance and accuracy. Oversampling helps address class imbalance and allows the model to classify smaller classes more effectively. However, we noticed that increasing the number of training epochs with this approach leads to a drop in accuracy for the

[2] In-depth analysis of the results of the study protocol can be found in Consolandi et al. 2024.

oversampled classes. This is likely due to overfitting, where the model becomes too focused on the repeated examples in the training data, reducing its ability to generalize to new instances. The system is now able to understand the content of the different instances and to better classify this type of misunderstanding.

5. Evaluation phase

To evaluate our assumptions about the ability of LLMs to identify and analyze misunderstandings in dialogues, we conducted an experiment using two conversations involving patients 16 and 18. These cases were chosen because they exhibited clear instances of miscommunication. In the first dialogue, the patient initially states that they smoke but later clarifies that they are referring to e-cigarettes (vaping) when asked about the quantity of cigarettes. In the second dialogue, the patient mistakenly assumes the doctor is referring to a surgical procedure when the doctor begins discussing therapy.

The experiment aimed to achieve three primary objectives:

- Assess the system's ability to recognize misunderstandings.
- Investigate whether the length of the dialogue fragment influences the results.
- Determine if the system can detect potential misunderstandings, even when the participants do not acknowledge them.

The third objective is particularly complex, yet crucial to our study. In the context of doctor-patient communication, misunderstandings that go unnoticed or unaddressed can pose significant challenges to effective interaction.

We set up the experiment using the OpenAI Python library (n.d.) and the latest GPT-4 model. To ensure consistent results, we used a fixed temperature (0) setting. To maintain consistency with the dialogues, we wrote the prompts in Italian. Given the qualitative focus of the experiment, which prioritized understanding over performance metrics, we did not invest heavily in extensive prompt engineering. We thus simply ask to highlight misunderstandings between participants if found.

Based on our criteria, only one instance from the result qualifies as a true misunderstanding, while the rest are speculative, relying on the reasonable assumption that doctor-patient communication is often prone to difficulties. As anticipated, when we reduced the size of the dialogue surrounding the identified misunderstanding, GPT-4 demonstrated a noticeable improvement in its ability to focus on the specific misunderstanding. Despite GPT-4 presenting the misunderstanding across several points, all of them ultimately relate to a single issue - the patient's mistaken belief that she is undergoing surgery, despite the doctor's clarification that this is not possible.

Our final evaluation aimed to determine whether GPT-4 truly identifies misunderstandings or simply reacts to participants' responses. To explore this, slight modifications to the dialogues were required. Fortunately, the dialogues were authentic doctor-patient exchanges where misunderstandings are naturally resolved, allowing us to make adjustments. Specifically, we moved the explanation about the surgery's impossibility earlier in the conversation and altered the patient's response to be more assertive. These minor changes led to a significant shift in the analysis.

The analysis revealed a key flaw: GPT-4's recognition of misunderstandings seemed to depend more on the participants' reactions than the substance of the dialogue.

6. Conclusions

This study addresses the challenge of detecting misunderstandings within risk communication dialogues in healthcare. We begin by examining this issue from a philosophical perspective and subsequently present a focused use case that demonstrates the significant shortcomings of state-of-the-art approaches in achieving satisfactory performance. The findings support the hypothesis that the complexity of this task necessitates further exploration. Notably, framing the problem as a text classification task yields promising initial results. However, the data distribution is highly imbalanced, with a significant bias toward a single class. To mitigate this imbalance, two complementary strategies are proposed: increasing the volume of annotated data for the underrepresented classes and employing more sophisticated data augmentation techniques beyond simple oversampling.

While the initial results are encouraging, our evaluation highlights persistent challenges, even for advanced large language models such as GPT-4. Specifically, these models struggle to accurately identify misunderstandings, often conflating them with general communication uncertainty. In particular, misunderstandings that remain unaddressed by dialogue participants are frequently overlooked entirely by GPT-4.

Future research will prioritize several areas, including the acquisition of additional annotated data and the development of innovative approaches to better detect and interpret moments when dialogues deviate from their intended purpose.

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